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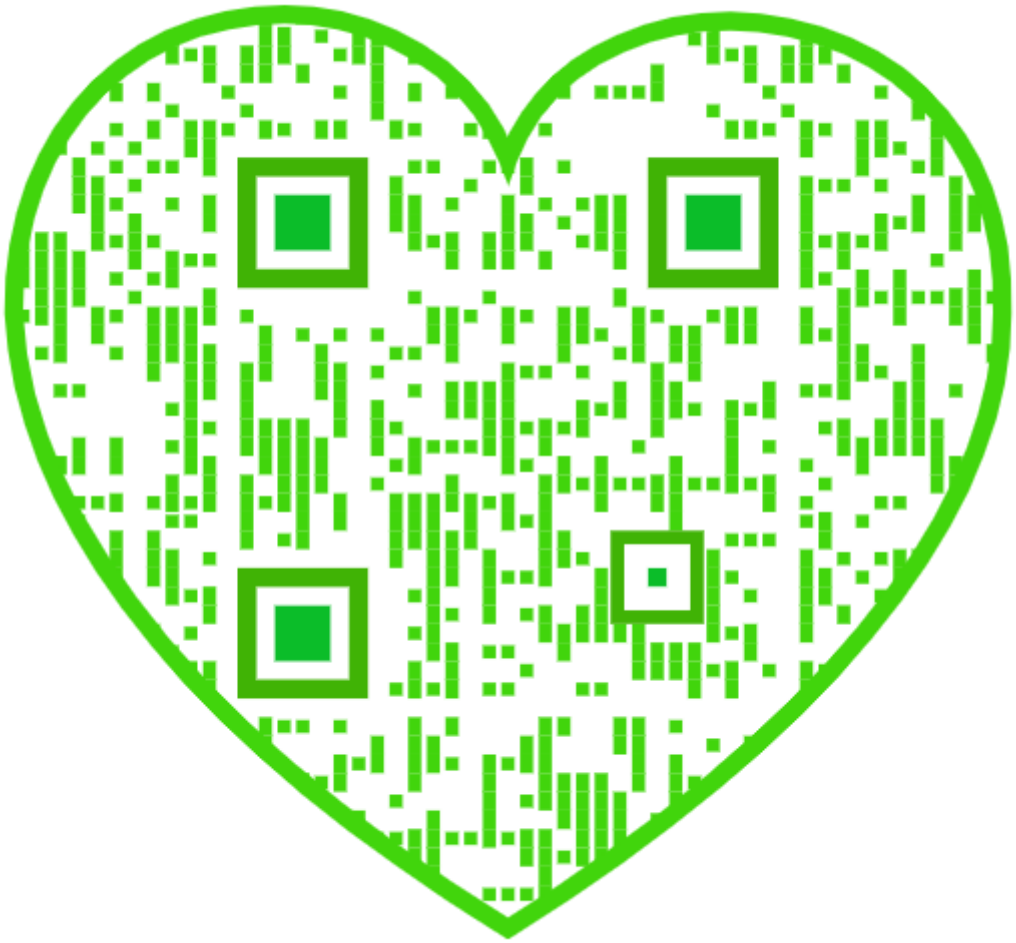

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UNITED STATES OF AMERICA.

BREEDING AND REARING

OF

THE SILK WORM.

A FEW HINTS

TO THE

FARMERS OF THE SOUTH.

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BY L. S. CROZIER.

No. 14971.

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BREEDING, REARING

— AND —

CULTURE OF SILK WORMS.

PREAMBLE:

Is there any need for me to demonstrate the immense advantage of the silk worm? These are too generally known, and the limit of this small treatise too narrow for me to explicate at length on that part of the subject. I will content myself with having you to observe that this culture brings into existence numberless first-class industries, and imparting life and motion to all those great or small, already established in the country, and to the agriculture as well, by drawing and settling in the country a considerable population of workmen and traders who consume the products of the farmer, and constitute at his very door a permanent market, by reviving and increasing the commercial movement in all its various branches, by bringing in the cash capital and increasing four-fold the value of land. There is not one person in the country who can remain unconcerned in the progress of silk culture; not one but has a strong interest in it. The rich will find there a profiable use for his funds; the workman a steady employment; the mining industry a powerful help on account of the large amount of fuel used in the factory and spinning mills, and the farmer a sure resource.

One of the peculiarities of this industry is its aptitude to be divided and sub-divided indefinitely. Silk is like a precious manna, which every one may gather according to his strength and ability to work. There is even something more than this, for the poor can reach to it as easy and more surely than the rich, for experience has proven, long ago and everywhere, that breeding on a small scale is almost always a sure success, and at all events runs much less risk than breeding on a large scale, which is the more exposed to disease as the worms are more in number. Another advantage of a limited breeding is, that it requires scarcely any expense. Every year, a few weeks in the smallest cottage with an acre or two of young mulberry trees, one will make first $50 then $100 or $400 worth of cocoons, without neglecting the other culture, bring into usefulness the girls, children and the old during the first stage, and men only for eight or ten days, when the work needs hurrying. Then money will come, truly a discovered treasure for the poor family, coming in so fast it will seem as if it had been dropped directly from above. And why should we not see done here what we see done in France? There even the highly educated ladies participate in this interesting business, as they would in a plaything making, at the same time realizing a nice little profit of $90 to $100 or more.

To sum it up: Breeding on a small scale is so easy that in silk growing countries you see it multiply indefinitely and become the true source of wealth, for they make at least three-fourths of the general production of silk.

For more extensive breeding, which needs costly buildings and other

expenses, though it requires more care, more practical instruction, and is more exposed to failure than limited breeding; it is likely to succeed better here than in any other place in the world owing to the remarkable qualities of the climate. Further, it is useful and indispensable to impart impulse to industry and to spread it in a new country. It is not expected from a poor farmer to go into planting mulberry trees and raising silk worms in a country where he supposes there is nobody to buy his cocoons, because he does not know that he who has cocoons, secures the whole world for his market; that should *his* country refuse to buy them, Italy, France, Spain and even England will always send him gold for his goods. This the rich man knows, and he is to set an example and take the lead. When the most intelligent, the most devoted to public progress and their own personal benefit have seen and handled the results and proved how easy and surprising the success is which await them in that direction, it will then happen with the culture of the silk worm in America, as it happened in France with the culture of the potato, tame grasses, etc., once so difficult to introduce, and which afterward spread so rapidly, becoming a great resource for the whole world. I say it will be the same story again with the silk worm in Louisiana, Mississippi, etc.

The experiments made at Silkville with the breeding of silk worms, have already proven how particularly adapted to that culture your climate and soil are. By erecting his factory for milling and reeling, M. de Bossiere, will go one step farther, and set up in your midst a ready market, even in advance of the production, so that the most obstinate cannot preserve the slightest objection to oppose. As for me, I shall feel happy and proud to bring all the intelligence and strength I may have to help this important enterprise and make it a final success. This I shall do with entire confidence, for with a leader so enlightened, so alive to the interests of all, and at the same time so resolute, with the abundant means at his disposal, and above all that, with a nation so full of intelligence and instruction, so anxious of improvements as the one we live with, the success is assured. I mean success in establishing and spreading the culture of both, mulberry and silk worms; as for the success of the crop, three years' experiments have thrice proved how easy it is.

THE MULBERRY TREE.

It being proved by facts that the naturalization of the silk industry in this country is not only possible, but even easy and economic, more so than in any other region of the world. Persons desirous of engaging in the silk worm business must, first of all, plant mulberry trees. A regular cocoonery need not be erected till the trees have grown up larger, the small temporary accommodations that may have been used are no longer spacious enough to hold silk worms. In the Mississippi valley buildings are plenty.

The mulberry tree belongs to the *Urtica* family; its flowers are *monoic* and *dioic*, disposed in close spike, oval or elongated, of which the females grow into compact juicy berries, containing the seed. Many (authors) writers say it originated in China, still it grows spontaneously in Persia, India and many other places in Asia, as well as in North America. There are two kinds or varieties quite distinct; the black mulberry tree and the white mulberry tree. The black one to the family of which the American belongs, yieds a great variety of excellent fruit. The leaves, strictly speaking, might be fed to the silk worms, still they are coarse and tough, and the worms do not eat them readily Those fed on them *exclusively* yield an inferior quality of silk. The white mulberry tree will grow fifty or sixty feet high with a trunk four to eight feet in circumference. The leaves, which produce the most beautiful silk, are alternate glossy on the upper side, smooth on both sides, oval, tough, with a little heart-shaped cut at the base, denticulate on the edge, often too, diversely divided in lobes when the tree grows wild, and whole on the grafted varieties. Sometimes on the same tree, no matter of what vari-

ety it is, leaves are found of different shapes. In color, the berries present numberless shades, from pure white to most perfect black. Fowls and pigs grow fat on them. Sweeter than raspberries, they taste agreeably when mixed with them.

The second leaves, gathered and dried in the fall, form a first class fodder for all herbivorous animals; green they are eaten still more readily.

The wood of the white mulberry tree has a fine compact grain, nice citron-yellow colored, and apt to take a beautiful polish. These qualities make it fit for several different uses; cabinet-makers, cartwrights and coopers work it to advantage. It has, too, a well deserved reputation for fence posts and vine stakes, lasting very long in the ground. For kegs and barrels it is as good as the best oak. The bark of the young limbs yield a kind of tow, smooth and pretty near as fine as silk. Olivier de Serre, the father of French agriculture, had some tablecloths worked out of it, worthy to be presented to Henry IV., his king and friend. Out of the same bark the Chinese and Japanese make the most strong and beautiful paper. As an ornamental tree the mulberry cannot be beat. Its natural tall bearing fits it nicely to border roads and public grounds, while with suitable pruning it will submit to any shape wanted, bower, hedge, etc., and more than all that, its growth is rapid; it stands the drouth so well that no other tree can be compared to it in that respect. For these many reasons the mulberry tree ought to supersede as ornament and shade tree quite a number of other kinds which are badly wanting in usefulness Gay, healthy foliage, so reposing to the eye, succulent berries, a delight of your children and birdies, without recalling to you its immense practical utility for the silk culture. Do not these points entitle it to a place of honor around your cottage? Plant mulberry trees then, men of the South, give it its due of care, and—my word for it—you will be paid for your trouble a hundred fold. See next chapter how to do it.

THE MULBERRY TREE PLANTATION AND CULTURE.

The mulberry tree is propagated from seed, cuttings and layers. From seed the trees are hardier and live longer, but they are born wild, and bring forth so many different varieties that out of a hundred there are not twenty alike. Very good stock has been sometimes obtained from seedlings, but, as a rule, they need to be grafted. We want two good points in a mulberry tree for our purpose, viz: good quality of the leaves and facility in gathering them. This implies large, soft, tender leaves, growing on long, smooth shoots without side twigs. This is very important, for on a good tree a man acquainted with that work could pick 100 pounds of leaves in one hour's time, while, on the other hand, some trees present such small tough leaves, and so very hard to pick, that it is better to let them alone and save time, except if it happens to be on the very first stage of growth, both of the worms and leaves; these last are then tender enough to be fed to the tender worms. Young, tender leaves are milk for them, leaves of wild mulberry trees are desirable too, for the first meal after every moulting period, which is a critical time for the worms, who, somewhat indisposed yet, need food fine and light, for which they show a marked preference. Since, then, that seedlings are not to be relied upon in that respect, it is necessary to set the largest number possible of grafted or selected trees in view of economy and facility in breeding. The mulberry tree may be grafted or budded; the graft is either cleft or flute, the first one being seldom adopted. The flute graft is easiest and succeeds best. It is practicable from April to August. A smart man can set from 250 to 300 grafts a day.

Whereas the white mulberry tree succeeds admirably from cuttings, the silk growers of America will do well to adopt that way of propagation to procure their stock, provided they take the cuttings from good

trees, possessing all the qualities described in this chapter; in that case there is no use for grafting.

The ground being prepared by deep plowing and harrowing, take your cuttings, make ready beforehand (we make them six or eight inches in length,) and set them three or four inches apart, in rows three or four feet distant. Two precautions are to be remembered. First, to press the ground firmly around the lower end of the cutting, and to cover the upper with but one-half or one inch of mellow earth, to alleviate the effects of a possible drouth, and to protect the upper eyes against the rays of the sun. Between the rows run the cultivator, but not so close as to hurt the young plants. There will be some work left for the hoe and hand, killing the weeds, always taking great care not to disturb the young roots, or to break the tender buds.

Layers are made by bending on the ground one or more shoots of the selected mulberry trees. These are pegged in the bottom of small ditches two or three inches deep, then covered with earth to the same depth. In that way often out of every bed springs a rooted tree. Layers are laid in February, March or April, always as early as practicable. They are severed from the parent tree by a cut in the fall, and planted out the ensuing spring, according to climate and country.

One thing cannot be too much insisted upon regarding the planting of mulberry trees: it is to plow the ground as deep as possible before setting the trees. It is a work that will be repaid a hundred-fold by the more rapid growth, by a larger yield in much less time, and by a superior quality of the leaf, producing in turn a superior quality of silk, and last, not least, by the longer life of the trees, which, as a precious inheritance, shall go down to future generations. There is one more reason for doing it in this climate: deep plowing will retain more moisture in the soil, and give the wood a chance to grow as late as September, instead of being stopped by the drouth in July or August, as it often does.

WILD MULBERRY TREES.

It is well, on the start of breeding, to have a few wild mulberry trees set in hedge in a sunny corner, sheltered from the north behind a wall, if possible, and trimmed every year close to the ground. The leaves being earlier, it affords a facility to have the worms hatched earlier too. The necessity of early and rapid breeding is greater here than it is in France, for a reason that requires some explanation. When the berries begin to ripen, the leaf is said to be *done*, which means that it has attained its full maturity; it then grows too tough for the worms to eat well, and, besides, develops itself into a side twig, which makes the picking very difficult, and hurtful to the tree by tearing the bark. Hence the importance to have the worms keep pace with the leaf, and be done eating within the very short period of softness of the latter. The more so, because the last stage of the breeding is a time of great hurry, when facility in rapid picking is particularly desirable, the worms eating more and more as they grow larger. By using early leaves of wild mulberry trees, as aforesaid, eight valuable days can be gained. Another advantage of an early start is to be through with the whole breeding before the hot weather sets in, which, though tempered by a ceaseless wind, causes a number of inconveniences. These are avoided by pushing and forwarding the growth of the worms by all available means, and this is one of the best.

These wild trees may be set one and one-half or two feet apart, and only as many as may be wanted to start the worms, or for a small experimental breeding.

Mulberry trees are trimmed in three different ways—dwarf, medium trunk, and high trunk or standard.

DWARFS.

If you mean business, and want mulberry leaves right away, make your land ready and set the trees in rows sixteen feet distant, and the

plants six feet apart in the rows. Form the crown of the tree by pruning or trimming it down one foot from the ground or close. Cultivate once with the plow between the rows, then with the cultivator as many times as is needed, the same as with corn. In that way two acres will feed enough of silk works to produce 145,000 to 150,000 cocoons, weighing 1600 or 2000 pounds, according to quality—that is, after the third or fourth year from planting, according to quality of the ground, amount of care bestowed on the trees, etc. Besides, for a few years, the land between the rows may be planted with some crop, like potatoes, without any harm to the trees. It will pay both plowing and cultivation.

MEDIUM TRUNKS.

These are to be set fifteen or sixteen feet apart each way, trunks three feet high, in good ground. Each tree planted in that way, six or seven years from planting, will produce from thirty to forty pounds of leaves, 100 trees, representing a little more than an acre and a half of ground, would yield, say 4000 pounds of leaves, or 400 pounds of cocoons, which, at a dollar a pound, makes $400.

HIGH TRUNKS OR STANDARDS

Are generally planted as border around the farm, as well as along the roads, around the house, or even in the open field, at thirty feet distance. In order to get a fine standard mulberry tree, it is to remain two years in the nursery without pruning. On the third year it is cut down close to the ground; the finest shoot is then allowed to grow, which in good land will reach in one season from eight to ten feet in height. The fourth year it is cut back to six feet or so. Then the three or four buds on the top only being left to grow, all the others are removed by passing the hand along the stem as many times as they grow again. The ensuing spring they are to be planted in holes wide and deep. I would advise every farmer to set a row of them around his claim. Suppose 160 acres square, surrounded with standard mulberry trees, thirty feet apart, which makes eighty-eight trees for each side, or 352 for the four sides; when eight or nine years old they will yield 100 pounds of leaves each, in all 35,200 pounds, enough to produce 1760 pounds of cocoons. I will suppose that they will be sold no higher than in France, which is seventy-five cents a pound, still it makes not less than $1320, costing not one single kernel of wheat nor an ear of corn. Taking into account the enormous duties on foreign silks charged in this country, I firmly believe that the American spinner will be able to pay for cocoons a dollar a pound, without danger of loss; they would then make $1760. You, who intend to beautify your homes, do you know among ornamental trees a kind that will make a more agreeable bordering than the mulberry tree?

PRUNING THE MULBERRY TREE.

When intended for an ornamental or forest tree, the mulberry tree needs only a little trimming to train its trunk straight and rid it of its dead limbs. Not so, however, when the use of the leaf is contemplated. It needs then a thorough pruning at least every other year; first, in order to check its growth, for in a short time it would become impossible to reach some of the highest or remote branches. A judicious pruning brings together all the shoots within reach of the hand, strengthens the branches intended as steps to climb up the medium trunks and standards, and removes pendant branches that would be in the way. It is an occasion for mending injuries unavoidably done to the trees during the preceding picking of the leaves, and for preparing for the next picking, so that one man on well trimmed trees will do the work of two on ill-shaped and limb-crowded ones. The operation is done on one year or two year old wood, as the pruning is done yearly or every other year, by cutting the growth to be preserved back to four or five buds, and the shoots, always many in number, to be taken off close to the branch or trunk. The limb must present a smooth sur-

face, easily covered by the growing bark. In South France the pruning takes place with the picking of leaves, as soon as the cocoons are done, till the end of June. They strip the trees every year, but this is not advisable here, owing to the high price of hired labor and the many various occupations which claim the time of the Southern farmer precisely in that time of the year. He will then have to do what they cannot do in France, on account of the enormous price of the land. Instead of one acre he will plant two, and let half of his mulberry trees go untouched for the next year, hatching just enough of silkworms to eat half of his leaves. The cocoons being done and sold, he will let his stripped mulberry trees put forth new leaves. Then in February and March, when he can hardly do anything else, he will take his pruning shears and remove the dead wood and bark and thin out the trees that have produced a crop the year before, and which, having a whole spring and summer before them to grow, will put forth branches so fruitful and in such number that he will have as many leaves on one-half as on the whole of his trees. These will thrive the better for that, and the work of picking be made easier, too, for I have explained it already, and you understand well that with smooth limbs quickly slipped through the closed hand, without any fear of getting hurt with the dead wood, with leaves, large, thick and healthy, a man can fill his hand and bag four times as quick as one working cautiously amongst suckers half dried up and scarred at the preceding picking, bearing a few leaves here and there. We have tried that system in Silkville this year, and have made up our mind to stick to it henceforth.

As for the young plants from cuttings, you will have to trim them only as you may want some leaves to experiment with, that is, you will remove all the small twigs that are eating up the main stem, and feed the leaves to a small quantity of worms, which may be bred and raised in your room in a box, always remembering to proportion the number of worms to the probable amount of food at your disposal. It will pay you fairly and initiate you into your future operations, by having you familiarized with the various transformations of that insect, better than you could be by going right away into wholesale breeding, for, in that way, you will have all the leisure you want to study well the precise moment of the beginning and end of the moulting period. And that is all you need know in this privileged climate which renders useless for you, so many cares and so much knowledge indispensable elsewhere.

A clean and careful pruning, made with good and sharp tools, presents so many advantages over that done carelessly and unskillfully that it is a point which cannot be too much insisted upon. A skilled hand will impart to the tree an elegant shape, manage steps for the feet, a prop for the back, or even a seat to rest on as the tree grows up, so that the man picking on the tree does more work, with less fatigue, than the one picking from the dwarfs, standing himself on the ground all day, with nothing but his legs to bear the weight of his body. The pruning-knife does the work very well, if sharp; a good sized branch can even be cut with it, by taking the well known precaution to make a cut first on the upper side, then on the under side, bending at the same time the limb upwards, as the knife penetrates deeper into the wood. Still a pair of good pruning shears is by far to be preferred. Never cut in flute, nor far from the bud, if you have any regard both for your clothes and your trees. In France the cut wood does more than pay for the work.

PRODUCTION OF THE MULBERRY TREE.

Almost every new beginner's first question is: How many worms, or how many pounds of cocoons can be fed out of one acre of mulberry trees, the first year, the second, and so forth?

Count de Gasparin, an authority in silk culture, says: The first year let the tree make roots and grow; the second year pick the leaves, and trim the trees carefully. The full production will be attained according, as follows: Dwarfs, planted four feet apart, give their maxima the

third year after planting, and the maximum one acre can produce; it last thirty years or more, according to the quality of the land. Planted eighteen feet apart they require five years to reach their maxima, lasting sixty to eighty years or more. Planted twenty feet apart the maximum is attained only ten to twelve years after planting, and so forth in the same proportion, till the distance of fifty yards apart. In this case the full production will come in one hundred years, and last at least six hundred, as it is proven by our oldest trees—the first planted in France.

I recommend planting in rows, twelve to sixteen feet distant from each other, the trees eight feet apart in the row.

One acre of mulberry trees in full production can feed 80,000 to 100,000 worms, or from 300 to 500 pounds of cocoons, according to the care, climate and soil.

SILK WORMS.

There is nothing easier than to raise silk worms and get cocoons out of them. It is a mere pastime for school boys, ladies or girls, as well as for men of leisure and science, all equally fond of following day after day the rapid progress, the astonishing metamorphoses, and last the wonderful work which precedes the transformation into chrysalis, in a silky grave, so well closed, so solid, that the greatest exertions, the sharpest finger-nails could not tear it open, though out of it emerges, apparently without effort, a tender and pretty white moth, the last metamorphosis of that insect. School boys and learned men, too, have tried curious and sometimes cruel experiments on these harmless worms, such as to dip them in ice-cold water, to starve them during many days, or exposing them to a sunheat of 100°, and all that without being able to kill them, or prevent their spinning their skein, for the cocoon is nothing but a mere skein, which is wound off from end to end with the greatest facility. Experimenting on very limited quantities of worms, learned men have sometimes, on the results so obtained, built up absurd and ruinous systems. There is no doubt but that the silk worms, when let alone on the mulberry trees, are hardier and produce a finer quality of silk; but the birds, mice, ants, spiders, etc., are against that mode of breeding, and make it impracticable. It is proved also that small breeding, of say fifty to three hundred pounds of cocoons, are a success next to infallible when undertaken with sound eggs, while large breeding requires particular conditions of space, ventilation and heat, more difficult to procure, but by the use of which admirable results are obtained. Very often a favorable season brings together these conditions, and I have myself seen in my own house (in France) in one cocoonery thirty-three ounces of silk worm eggs yield us thirty-three times 100 pounds of cocoons, which, being spun, produced 320 pounds of most beautiful silk. Now what affords me the most encouragement is the fact that the more I become acquainted with the Southern States, the more clearly I see them combine, year after year, regularly that temperature, those peculiar conditions, which, in France, have brought out years of memorable success; conditions which breeders in less privileged climates can secure only by increased care and costly means. The good qualities of our climate do not require me to go into long and tedious particulars; it will make your task and mine as simple and easy as possible.

The most favorable conditions for the health of silk-worms are a dry atmosphere, plenty of air and warmth, and an abundance of healthy food. From May 10 to June 10 is a period which will soon be called here the cocoon season. I do not think that it is possible to better fill these conditions than our natural temperature does. The leaf particularly is of a matchless beauty, and I have not the shadow of a doubt, not only of the success, but even of seeing all cocoons, no matter what breed they are, undergo here such improvement that they will be singled out on every market the world over, and bought at the highest figures, under the name of "Southern Cocoons."

The marked superiority of our second crop over the first one, out of which it was bred, while the first was out of direct imported Japan eggs, affords a full evidence to the statement. Samples of four different breeds, white, yellow, green and crossed yellow and green, sent by M. de Boissiere to the Chicago Fair, attracted the attention of silk men, who were unanimous in pronouncing every type to be No. 1. M. de Boissiere has been complimented by the committee, and that must be for the whole country a precious encouragement.

VARIOUS BREEDS OF SILK WORMS.

There is in existence a boundless variety of breeds among silk worms, distinct of each other by the colors of the cocoons, or even the colors of the worms.

There are, as for the color, three main divisions: white, yellow and green, with numberless shades.

Aside from the difference in color the silk worms are said to be of three or four moultings, according to the number of times they change their skin before they spin their cocoons, both living the same number of days, or, if you like best, eating the same number of meals, and both of fine quality, too.

We find the Polyvoltines breeding sub-divided as follows: the Bivoltines, hatching twice a year, the first time in April or May, like the other breeds, the second immediately after their eggs are made. The second breeding only gives eggs for the crop of the next year. By no means can one keep the first for another spring; they hatch or die soon after being made. Trivoltines hatch three times, giving three crops successively, the last only being good to be kept for next year. Quadrivoltines hatch four times, and the annual ones hatch but once. That would call for another division or distinction in Annual and Polyvoltines.

Experiments have proved that the crop of Annual is much better than the many produced by the other breeds, Bivoltines, Trivoltines, etc., with much less trouble.

As for the varieties of cocoons, they multiply with the propagation of the worms, and both color and fineness will change with the climate; or, more accurately, the same breed exported to six different countries, would, in the lapse of a few years, show six distinct breeds, differing in fineness, color or shade at least. Such is the origin of the noted breeds: The Milanese Italian breed small, fine, yellow cocoons, the Ardeche (France) large yellow cocoons and the Brousse (Turkey), the unrivaled, white cocoons, of which nine pounds make one pound of silk, selling at $12 per pound, while the common kind averages twelve pounds of cocoons to one pound of silk, selling only at $8 per pound. Here we have a proof of the change alluded to. In Andrianople and Brousse imported yellow breeds grew pale more and more, till they now produce silk of the most beautiful white, used in its natural state for the richest and most inimitable fabrics (dresses).

Nothing will be spared at Silkville, efforts or care, in securing and naturalizing the very best in the line of silky materials, and I believe our experience, climate and soil offer us a sure guarantee of success.

SILK WORM EGGS OR SEED.

We call (silk worm) seed the eggs produced or laid by that insect, when transformed into a moth. On the good quality of that seed success depends; hence the solicitude bestowed on that object by the most enlightened men in the silk growing countries, more so where they have been afflicted by hereditary epidemic diseases. Science at last gave them sure means to secure sound eggs, which, spite of the plague threatening to annihilate that industry in Europe, yields now crops as bountifully as ever. Eggs or seed produced in such a healthy country as this, do not need the same minute care they require in less favored districts. The same processes, however, have to be followed exactly,

minutely, everywhere, in the preservation of these precious eggs, from the laying to the hatching, ten to eleven months. A few words only will be needed to convey the necessary information.

The silk-worm seed is round, slightly flattened, of lilac, violet, or dark-green color, according to the breed it comes from, and as small as turnip-seed. Some will stick wherever they have been laid by the female moth, as if glued on pasteboard, paper, cloth, or even the very cocoon. The seed of some breeds, on the contrary, will not adhere—such as some of Caucasus, Persia, and European Turkey, among which are the white of Adrianople, the yellow of Caucasus, from Nouka. The eggs are by natural law submitted to a period of seemingly lifeless inaction, and so, during the whole summer, they will stand a degree of heat much greater than the one needed to hatch them in the spring. But from December it becomes possible, by giving them that same amount of heat, to secure a nearly perfect hatching. The experimental early winter breedings, so common in France and Italy, prove it every year. Therefore, if silk worms were kept in winter in a heated room, there is no doubt but what they would hatch or spoil. In shipping them by railroad or steamboat that same danger must be prevented, by not placing them in heated cars or too near the boiler. The most intense cold does not hurt them, and it would be better for them to be buried in ice than to remain exposed to a high degree of heat after the month of October. In order to avoid any excess, persons having a dry, well-ventilated cellar, will do well to hang their pasteboard, paper, or cloth, if adherent, or in small bags if loose, with a string to a nail in the ceiling, taking care to pass the string through a bottle-neck or a piece of tin, to keep away the rats or mice. If there is no such cellar, the eggs may be kept in a cupboard, or, better still, hung in a room or hall where no fire is made, or in any cool, dry and rat-proof place. Cloth used for bags must be clean. If loose seed is kept in tin or pasteboard boxes, holes must be provided to secure ventilation. Cool, dry, ventilated and rat-proof; remember that.

HATCHING.

In all climates the time of hatching the eggs depends on the vegetation of the mulberry tree. In Ardeche, for instance, they wait till the leaf is at least the size of a silver half dollar, because there the weather in May is usually cool and damp, sometimes even cold during the whole month, and the leaves grow slowly. I have seen the buds open in April, or even in March, yet the berries green as late as June and the leaf not fully formed as it needed to be to finish the breeding (or near the end of the breeding). There then (in Ardeche) is no use for hurry, for the worms grow faster than the leaves, except in rare years, when fair weather keeps fixed, in which extraordinary results are obtained, as aforesaid. The South enjoys the rare advantage of having that temperature every year. Whether sooner or later, as soon as the buds are seen to commence swelling, the eggs must be removed from the cellar and put in a room kept to the outdoor temperature. The same cause which makes flowers and grass come up will hatch your silk worms in the most safe and natural way. Be careful from the very start of the breeding that the temperature never descends too low during the night; to prevent it put some wood in the stove before you go to bed, or, if more convenient, put the eggs in a basket on a white cloth, wrap a blanket around the basket and put between the blanket and the basket three or four bottles full of very hot water, renewing the water in the morning till the warmth of the day makes itself felt again.

Wherever the mulberry thrives it is possible to raise silk worms successfully; it requires considerable more labor, expense and knowledge in cold and damp countries than in those having a temperature like ours. I shall therefore not speak of the various methods of hatching of several countries visited by me both in Europe and Asia. Remember

well this: as soon as your eggs are set to hatching, whether it be by natural heat or artificial means, keep them always between seventy-five and eighty degrees Fahrenheit. Experience will show you that it is an easy thing. Last spring I let my eggs hatch in my room, through which the kitchen stovepipe passes. In daytime, about three or four o'clock p. m., the thermometer often rose to eighty-five; in the morning it went down to seventy; this was too much variation. I tempered this simply by putting some fire in the stove during the night. The heat of the pipe sufficed to preserve a moderate degree of seventy-five to seventy-eight, and the crop proved to be a splendid one. For the part of the eggs which were farther back than the rest, I used the system of the bottles to push them forward, and the thermometer never varied one degree by changing my four bottles three times a day—the first from six to ten o'clock in the evening, the second from ten in the night to four, often three, in the morning, and from this last time till evening, owing to the warmth of the day, being exactly the same as the one I had given in the night. These produced a fair crop, too, the worms hatching in three days. Finally, another part hatched without any care, at the natural temperature, and the cocoons were just as fine as the others, but they were eight days later than the rest. It is then best to help nature a little, particularly on the start, and during the course of the breeding, too, if a sudden extraordinary cold should come on, rather than to trust the weather to do the work. The expected goods will arrive so quick, and the pains to take are so little, that one would be very sorry to lose a crop, or part of it, just for neglect, even if it were but once in ten years. To keep the eggs in an apartment directly under the roof in the daytime, and in the bed with you during the night, is a means successfully used in such latitudes as ours.

When the eggs are on the point of hatching, they undergo a marked change of color, they pass from dark lilac to ashy lilac, and become quite white when the worm is out.

IMPORTANT OBSERVATIONS.

Before going further, I must give you a few notions intended to explain a good many things, which you would understand with difficulty, or otherwise would want long and tedious explanations.

They count five different ages in the life of silk worms, from the hatching, according to the number of times they change their skin. These ages, too, are termed molts, or sleep. The silk worms are equally said to be on the first, second, third and fourth moulting, as well as to sleep for the first, second, third and fourth time.

The first age takes place between the hatching and the first moulting; the second between the first moulting and the second; the third from the second to the third moulting; the fourth from the third to the fourth moulting, and the fifth and last extends from the fourth moulting to the "going up" or spinning of cocoons.

Nature gave the worm the faculty of spinning the solid cocoon, in which it wraps itself, and of which man makes such luxurious use, against all dangers that might hurt it as soon as it is transformed into a chrysalis, a state of insensibility which it preserves from eight to twenty days, according to breed and climate, before it emerges as a moth. The heaths or other branches disposed in cells, on which the worms climb to make their cocoons, imparted to that last moulting the name of "going up" (ascend.)

One precious thing is, that the time which is to extend between the hatching and the "going up," depends entirely on your own will. The age of silk worms is counted by the number of meals they have eaten, and not by the days spent from their birth. They eat more or less, in proportion to the degree of activity imparted to them by the heat. At a cold temperature they are benumbed, and eat scarcely any. Hence that essential rule: In warm weather feed frequently. The more rapid the breeding, the sooner one is freed of the cares inherent to that

particular industry. Some leading breeders made an axiom out of the following by-word: Give fire, air and leaf. Here in the South we will say; Climate furnishes you with air and heat, feed oftener; as the heat increases, give more air, too. For the reasons given above, it is easy to bring to evenness a party of worms which took three or four days to hatch. You must separate day after day successively the worms as they hatch, making as many divisions as they take days to hatch. Then take the first hatched and put them in a room less warm than that where the others are, and feed them only twice or three times a day; meanwhile feed the others five or six times a day, till the second hatched overtake the first. They (the second) then join the first in the cool room, and are fed like them, but twice or three times a day, till the third, fourth, etc., pushed forward by warmth and numerous meals, come and join them successively, when they all may be treated together at the regular allowance, both of food and warmth. They should all go through the moulting at the same time.

HATCHING—TAKING UP THE SILK WORMS.

When the eggs have changed color, and from violet have passed to light blue or an ashy color, according to the breed, they will soon hatch and need watching. Silk worms usually hatch from three to eight o'clock in the morning, and the *taking up* is to be done in one out of two ways, as the seed is loose or sticks to cloth, pasteboard or paper.

If the seed is loose, spread it evenly on a clean cloth in a box; stretch above a sheet of tulle or perforated paper, to prevent the eggs from sticking to the leaves, and being lifted with the worms. Near five or six o'clock in the morning, if you see some hatched worms, lay softly on them (instead of loose leaves) whole young twigs, spacing them more or less to suit the quantity hatched. With these twigs, bearing two or three leaves, it is a great deal easier to move the minute and tender insects on the paper sheet, where they are to grow till the first age.

At about eight o'clock or earlier, if the leaves have been rapidly covered with worms, the twigs, one by one, are taken up softly and put regularly spaced on a newspaper, or any other clean sheet of paper, taking care to leave a broad margin, for they grow very fast, and after every meal want more room. If there are worms left yet on the cloth, renew the leaves and take it up in the same way before you give a second meal to the first, in order to keep them periectly even. When the last hatched have eaten their meal (of twigs), or better still, after the second taking up, leaves are chopped like course smoking tobacco, using a strictly clean and sharp knife, preserved expressly for that special use, and feed them to both parties together.

That paper or box where you have just fed them, is then labeled No. 1, first day. Those hatched the next day will be marked No. 2, etc., to the end. According to the amount of care bestowed on the preservation of the eggs, they will all hatch in two and three or eight days, and always in the morning. Those coming out at night or in the evening, are but few, and may be as well taken up or let alone to await for the others.

Breeders like to hatch a few a couple of weeks in advance of the whole bulk in order to test the quality of the seed.

EVENNESS OF THE SILK WORMS.

Evenness in the worms is a matter of the utmost importance.

First—The inview of the moultings. If your worms are very even, if they commence and finish their moultings altogether, at same time, when you remove their litter (which is necessary at least once before each moulting), all will keep at same time on the fresh leaves with which you are to take them up, and you need not to lose any; on the other hand, if they are uneven, some being moulting, they will be buried and die in the litter beneath those who are eating, and it is in

vain that you try to catch the right time to take up, you are sure to throw away part of them with the litter during the whole breeding. The trouble will keep growing all the while to the end, when some would be wanting a suitable place to make their cocoons, while others would keep eating many days yet. It is very easy to prevent that difficulty to maintain as well as to obtain a perfect uniformity. It requires only attention, and look to it from the very hatching. So one will be careful not to mix the worms of one day with those of another day, an easy thing to avoid by means of labels, and it will be all right as far as the first moulting. But at that period one might unmatch them by feeding before they are all quite *awake*, which means, before the transformation be complete. To avoid this, one must know that particular moment, and I am about to show it to you as best I can, bringing you to it by the number of meals and the different appearance of the insect; for the worm that was just born, exactly one twelfth of an inch in length, English measure, can now be seen in all its parts distinctly, and with the look of the insect, as by means of other observations, there is no possible mistake for the beginner in breeding.

The best way is to mark the meals, an easy thing by making a stroke with a pencil on the edge of each paper sheet every time you feed. One thing not less essential, is to spread the leaves very evenly, so that part of the worms, cannot eat more than the others. After eighteen meals, including the one given in taking up your worms, most of them will be buried beneath the leaves; the others, as many as can be seen, will have a short, thick-set body, large head, and be scantily scattered about. It will look as if half of them are dead. Feed then one, two, three more meals, always still with chopped leaves, but very sparingly in order to bring to readiness the tardy comers, if there be any, but when they commence emerging after moulting, and as soon as you see some fellows more slender, with elongated snout, very broad, much broader than the sleepers, wandering about and eating well, stop feeding and let them fast till all the worms have come out; that will not be long. By and by, the worms will thicken, and in eighteen hours they will all come out, if the temperature be warm. For prudence's sake, it is well to wait twenty-four hours.

If marking or counting the meals has been forgotten, one can tell that the worms are going to moult, when (after they have commenced by devouring the leaf), they gradually lose appetite. The body swells, they stick with their silk to the leaf (which they do not eat any more,) in order to rid themselves of the skin, and stand motionless, the head slightly raised up, then the snout loosens itself, and the skin is let go, and given over as a useless sheath. It is very easy to tell a wide-awake worm amongst sleeping ones. It is more difficult to tell a worm just coming out of moulting, from the one that has scarcely commenced going into it. A watchful person will know a worm which has undergone the transformation by its lengthened and comparatively more slender body, its lighter color, its snout too, changed in color and twice its former size. The snout is the only part of the worm that will grow no more till the next moulting. The sudden growth of that part, makes a marked difference, remarkable amongst all others between the two worms at all moultings. It is striking when the worm that has just moulted, and the one about to do it, are side by side. The period from hatching to the first age is very delicate and deserves the greatest watching. Like with babies, the light and watchful hand of the woman makes an easy job of it. They are fed six times a day, which makes three days duration for that age.

First Molt—Same minute care; after eighteen to twenty-four hours fasting you give one first meal of young whole twigs. At the fourth or fifth meal when the worms are all on the leaves that you took care to feed somewhat more freely (plentiful,) you clean the litter. To do it, you need again to pick one leaf after another, one at a time, and space them so as to double at least and sometimes treble the space allowed to the worms. If there remain still any, and there remain always

some, you spread a few leaves on the bed, to gather the last ones before you throw away the litter. From that moment you feed chopped leaves spread very evenly, as much between the worm covered leaves as on the worms themselves. They will spread to the interstices to reach fresh leaves, and get distance naturally, from the first meal; you will continue in that way, feeding five or six times a day, till the second age. After eighteen meals make the same remarks much easier than the first time. Let the whole bulk of them come out well before you content an appetite that has become devouring.

Second Molt—The Silk worm, quite black when just born, a little less so when out of the first moulting, is now of a dark, almost ashy hue. Whole leaves are fed from the first meal, the litter is removed, and the worms are spread on an enlarged surface, and as soon as they appear to lose appetite, and commence putting on the big head, then leaves are chopped, fed sparingly, etc. During that period, four meals a day at least are needed, or five if it can be done.

Third Molt—If your worms stand thick when just out of the second sleep, they must have three times as much room again, to be able to acquire without being too crowded, the size they will have on the fourth moulting. If you cannot give four meals a day, you will give but three somewhat more copious, and during three days, they will devour the leaves. It is the time of the first little hurry which corresponds to the time of greatest hunger. The sleep is the time of moulting. By that time, the worm has become entirely white if he belongs to the breed of white worms; those who are to furnish yellow silk, you will know by their feet, which are exactly of that color, those producing white silk have white feet. There are breeds that will remain black, or iron grey, some have rings black and white, tiger like, etc. The color whatsoever it may be, give yellow, white or green cocoons. The litter is to be cleaned twice.

Fourth Molt or fourth age.—The first transformation is easily effected; this seems to be the most laborious, and it is the most dangerous; when it is effected smoothly, success is almost certain. At every moulting, the very color of the worm is dimmer, and whitens gradually; at this moulting it is almost terreous. The worm is lean and feeble; as soon as the greatest part of them is well out, it is necessary to give them a light meal with wild leaves, if there is any left yet, without waiting for the last ones. At the first meal, they will whiten some, at the second, third and fourth they are quite white, and grow visibly. Now the hurry has come, throw them plenty of leaves at least three times a day; when this is done, you hear immediately a noise of a heavy shower falling on the green foliage, it is the noise of their teeth chewing the leaf, which they gnaw close to the wood. If you have a great quantity of silk worms, you will have for eight days regular hard work, but it is only for eight days, after which comes the reward. That thought will impart you renewed energy. Eight days are soon gone.

FIFTH AGE.

Putting up the Heath.—Six or eight days after the fourth sleep, if you see the worms losing their appetite, taking a dislike for the leaves, shrinking from it, growing smaller, becoming transparent as if containing a clear liquid, gold colored for the yellow, for the other colors, the color of their silk; and raising their heads, which they move to and fro; if some commence spinning their cocoons among the leaves or climb up the shelves, it is time to give them the heath.

HOW TO SET THE HEATH.

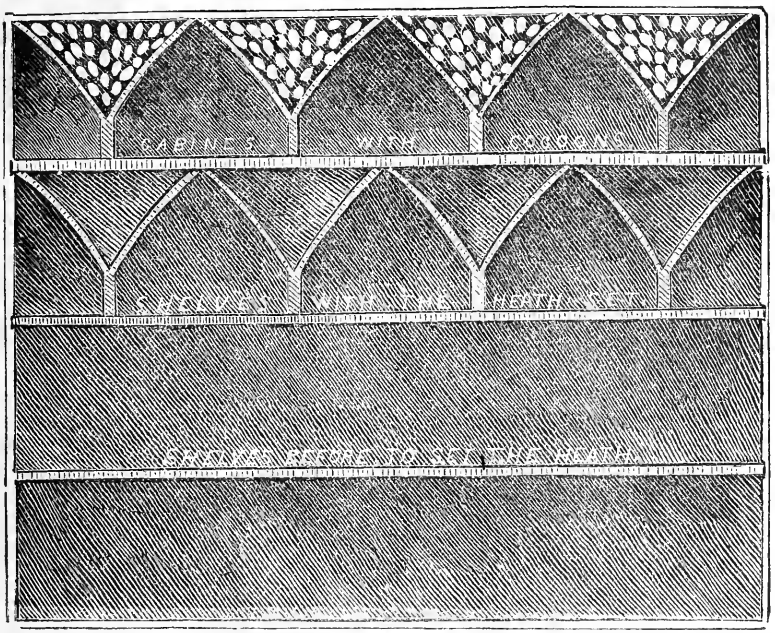
To set the heath or give wood, means to prepare cells for the formation of the cocoons. In many districts of South France heath is used for that, hence the term now technical: set up the heath. Branches of evergreen or common oak, olive tree, etc., are used too. As well as wheat straw or colewort straw. I have found here plenty of shrubs and

other plants among weeds which will do just as well as our heath. Their names will be given further. They may be gathered and prepared in winter, and kept tied in bunches ready for use. These branches must be cut four inches longer than the intervals between the trays or tables placed over each other, first to have them tight, and to form above each table a branchy ceiling close to the underside of the next table above, leaving as little space of its boards uncovered as possible, the worms being apt to fall from a bare board, and not be able to climb up again. To do that, the branches, or small bunches of weeds are set up perpendicularly, in straight rows across the tables from edge to edge, commencing with the uppermost table. Generally the ceiling is used to prop or rest the top of that first set of branches, otherwise, loaded boards have to be disposed at the required distance above the upper table. The branches set up perpendicularly head upwards, stem downward, in perfectly straight rows, are bent in their upper part alternatively right and left, against the upper boards or table, so as to form ogive-like arches. These arches would heave up the uppermost tables, if not fixed, and all the others successively.

Have the stems close enough to each other, so that the wandering worms may find them easily; the branches bushy, still not too thick for the worms to work easy among them. The rows about fourteen inches apart must be very straight to enable the operator to continue feeding and leaving the litter in these new compartments. That work is considerably shortened, or rather entirely suppressed, if the hurdle system used in the cocooneries at Silkville is adopted. These hurdles, in which the worms appear comfortable and easy to attend, are very handy to be moved from place to place, and are made of a double row of cleats so disposed as to enclose the cocoons in their intervals. Ladders are made in the same model, and then ready the moment of setting the heath. Their use dispenses entirely with the work of the preparation and putting up of the branches.

One not used to the raising of silk worms can have no idea of the feeling imparted by the sight of these thousand insects, starting to motion, climbing up the branches, looking for a favorable spot, then leaving a fine, thin thread at every attainable sprig, surrounding himself by degrees with a transparent gauze, which is not silk yet; it is the floss. When the insect has achieved the preparation of the ground by means of all these ties, then commences a regular work. An elegant form is shaped, the silk worm is seen yet, but the tissue thickens rapidly, taking in color, green, white, yellow or red, and the insect finally disappears. In twenty-four hours its cocoon is perfected. Imagination can scarcely conceive how an insect always seen so far destitute of quickness, can, in such a short time, work out a ball whose only thread is often 1300 yards in length, so easily wound off that the reel on which it is wound up, more than two yards in circumference, may be made to turn as fast as the wheels of a carriage driven at full speed, and if the spinner is attentive the thread will not break.

HOW TO SET THE HEATH.



Yet, spite of all care and pains taken by the breeder to insure evenness in the worms, they will not go up all the same time. It takes often four or five days for all those of the same party to make their cocoons. It is indispensable then to multiply the meals as much as possible, by giving a very small quantity of leaves each time, for every instant some of them give up the leaf for the wood or branches. Then, too, they rid themselves of all the matters contained in their body, and soil the food for the others which remain behind. Feed, then, little and often; the best way to secure that result is to chop the leaves. A handful of cut leaves will spread itself on a whole case, and each worm takes the little he may want to get quite ready. With whole leaves one feeds always too much, and with great difficulty. Not having a regular leaf cutter, I found out a most speedy way to cut it rapidly. Here it is: Grind very sharp one of those scythes, like hay knives, used to cut hay from the stack; gather the leaves in a heap, pressing them under your knees; cut first the sides all around, so as to have the heap square, then you may go on cutting an inch or so in thickness, for it is useless to cut it too fine. In this way, a man can cut a hundred pounds of leaves or more in a quarter of an hour. A leaf cutter does no better. The advantages of cutting the leaf are to make double the quantity of work in spreading it on the worms; to save at least one-half of the leaf, and consequently time in picking it; by sparing leaves avoid fermentation or the litter, of the trouble of cleaning at least one time; and last, to prevent worms from being injured by fermenting leaves, and some of them to make their cocoon among the leaves, which occurs very often, when the leaf being whole and mixed with twigs, they find interstices handy to work them in. Such cocoons are lost or spoiled too often. The cut leaves do not present such danger. In no case is a due degree of warmth needed more than now,

while the insects are forming their cocoons; this enables them to draw forth and to surrender promptly the whole amount of silk they have laid up in store. Ventilation, by all means; with it you save leaves, time and silk.

When nearly all the worms have come out, and but few remain in the cell, they must be taken out one by one and put in separate cases prepared for that use. It is worse than useless to spend an hour's time in feeding a few leaves in a hundred cells to worms that could be held in one. Immediately after you remove the litter, and then work is done; you have nothing left to do but to harvest.

GATHERING THE COCOONS.

Six days after the silk worms have come up, the collecting of the cocoons may be commenced. Still, if the weather had been cold, it would be safer to wait a day or two more, that all the worms would be transformed into chrysalis. Nevertheless, it is easy to ascertain it by shaking a few cocoons taken at random. If they emit a dim sound it is a pretty sure sign that the metamorphosis is completed. You may commence.

The first thing is to take apart the bushy cabins where the worms first climbed up. With precaution the wood is taken off and carried to and laid down carefully, by the persons whose business it is to gather the cocoons, care being taken not to crush any. The women in charge of them have to examine them first to see if there are any spotted or stained; if so, they must remove them at once, being careful not to soil the other ones. Then the clean ones are taken one by one neatly, the good one side, and the weak or soft ones on the other side. The sound ones are easy to tell by their firmness and solidity. The soft ones, if mixed with the others, would be crushed, and would stain them. One cannot be too careful in that respect, particularly when the cocoons have to be shipped.

When the baskets are full, they are carefully weighed and spread on the same well cleaned trays or cases, where they spent their lives. They need be handled with precaution, and not be heaped too thick, still at six or seven inches in thickness there is no danger.

That operation being done, the finest cocoons are picked out for seed next year. Select the strongest, most elegantly shaped, and those whose tissue or thread is finest. If white, take them of purest white, neither soft, nor satin like; if yellow, give the preference to the straw-colored, which are the most sought after; and last, if they are the green of Japan, the greener they are of a dark and sharp color, very glossy, the better is the quality of thread. Discard the pale shades in the last breed.

Some breeders think that cocoons well rounded on both ends, broad in the middle, contain females, while the more slender, pointed on the ends, are males. I do not believe it correct, and think it is next to impossible, to the smartest connoisseur, not to be mistaken. Besides, whether you pick them out at random, or select them carefully, there will be a number nearly equal of both sexes.

Twelve or thirteen ounces of cocoons will produce one ounce of seed or eggs, unless the males be too many in proportion to the females, or the moths not all very robust (stout). Finally a hundred females can give 40,000 eggs, which, if they all come out well, would produce 130 pounds of silk, and more for some breeds in which 200 cocoons makes a pound, it would then be 200 pounds. It is to be understood that these figures can only be approximative, still they often prove to be correct in small breeding, and I have myself bought and brought to seed in Asia Minor, whole lots of cocoons, out of which I obtained one pound of seed from twelve and one-half pounds cocoons.

When you have selected the cocoons for seed, there remains nothing for you to do but to carry the rest of them to the reeling factory, or to the agent of the reeler. It is customary for extensive reelers to have

agents, in remote districts, who receive and ship forward the goods. There are such in all silk growing regions. If there is neither factory nor agent at hand, the cocoons are to be smothered and dried, after which they may be shipped to any distance, and sell on samples in all and every market of the world. To ship cocoons or to send gold is just the same; you never meet with refusal. As for you, sericicultors of Louisiana (that is to be), you will enjoy the rare advantage of having spinning factories before you have cocoons to sell. Hurry up, then, to produce them.

STIFLING THE CHRYSALIS.

If you cannot sell your cocoons as soon as you have gathered them, you must stifle the chrysalises, so as to reel or set them at any time after. Our farmers in the Cevennes mountains use ovens to kill them. They put their cocoons in bug baskets, cover them with old cloths, making an oven full or two, after the bread is drawn, (a brick oven contains twelve long baskets, covering twelve square yards). After half an hour in the oven they remove the hot cocoons from the baskets on the floor all together, and cover them all with blankets to stifen them completely, and then, after a few hours, they dry them upon the shelves, where they are examined for the mite, a little insect which eats them. Every bored cocoon is good for nothing.

The surest and best mode of stifling the chrysalis is to do it by steam. Every flour mill can do it easily, having for that purpose a kind of wardrobe containing eight or ten bases or shelves in rows, one above the other, and shutting hermetically. When the boxes are full of cocoons, steam is turned in during ten minutes; the wardrobe being well shut up, let the steam do its deadly work for ten minutes more, then dry them in the sum.

Here the cocoons need only to be fully exposed to the rays of the sun, from nine o'clock in the morning till four o'clock in the afternoon. Two or three days of such exposure is sufficient. But, as some time, strong wind can anihilate the effect of the sun warmth, it is good to have for that purpose long boxes, four feet wide, sides six inches high, to be covered with glass frames. This will increase the heat, and by absorbing the air of the box, stifle your chrysalis most surely.

BUTTERFLIES.

Cocoons selected for seed are usually preserved in chaplet or chain. Great care must be exercised to take with the needle the least possible of the stuff, so as not to hurt the chrysalis nor to spoil the moth.

These chains or chaplets are hung in a well ventilated passage or room, protected from mice. As early as the twelfth or fifteenth day the butterflies commence to show themselves. You can readily single out the males; they are smaller, more slender, with incessant fluttering of the wings; from the more quiet females, with their large belly full of eggs. They will pair themselves together naturally; still they happen sometimes to be too far from each other to meet readily. You then bring them together, and as soon as they are joined, take both of them by the wings and set them on a piece of pasteboard or paper, disposed in a room or corner made as dark as possible. to prevent the males from uncoupling themselves. They begin to emerge out of the cocoon from four to eight o'clock in the morning. Supposing, as is generally the case, that by half-past eight they are all paired. six hours later, that is about two o'clock p. m., you separate them. Meanwhile visit them two or three times, and if some have uncoupled themselves before complete impregnation, unite them again. Should you have males to spare, put them in a closed box and preserve them for the next day, for it might happen that some other day females would outnumber the males. If, on the contrary, on the first day you have fewer males than females, instead of separating them at two o'clock in the afternoon, take as many males as you want, by uncoupling some pairs at ten or eleven o'clock. Take the best looking, they are always the strongest.

As you go to uncoupling, put the females on a cloth or paper hung on the wall or on a rod, to insure cleanliness in the seed, for if you should spread them on a table they would soil each other and stain their eggs, too, with their droppings. Preserve the males in a box by themselves, avoiding to mix them with those not yet used, which are preferable; but sometimes both are wanted, particularly the last day. As the females, whether paired or not, never fail to lay their eggs at two o'clock p. m., one needs always to have males to spare in store. As soon as she is uncoupled, she commences laying small eggs, yellow the first day, and which gradually acquire their natural color in three days.

The moths live for about twelve days from the breaking out of the cocoons. If the seed has not been impregnated, it remains ever yellow and after a while dries up, while that which has acquired the lilac color stays round, slightly flattened, but always full till the next spring. It is left to dry where it was laid, for some days, when it is removed to a place cool and dry, as already explained in the forepart of this book.

Never forget that rats are very fond of silk worm chrysalises, moths and eggs. They will cut through the cocoon to get the worm. In short, they feast on that insect and relish it, no matter in what dish or shape; keep them off carefully.

If stained, ill-shaped, feeble moths are found, feed them to the chickens. It is better to have less seed than to have some of inferior quality mixed with the good. Especially never procure seed from a region where silk worms are affected with certain particular diseases, and such districts are many, but apply to capable and, above all, to honest persons.

I will now speak about silk worm diseases, though I think it may be perfectly useless, owing to the excellency of this climate. Still it would be possible for you to kill your silk worms by feeding them wet leaves, or gathered too early in the morning with the dew on. Let them fast a whole day, rather than to impose them to such risk. Always have at least two meals gathered in advance, and near the close of the breeding one day's food for the next in extensive large breeding. In small breeding it is practicable to cut whole branches, and put them in-doors to dry, after shaking off the rainwater, or, to make the best of a propitious hour, to gather in a few moments the needed provision. If there is any dew, never pick your leaves before the sun has dried them.

DISEASES OF THE SILK WORMS.

It is useless to go back in the history of the silk worms, previous to 1869, if we will not be exposed to renew some old error about the diseases of the silk worms. The progress of the microscope has since clearly demonstrated that the characteristics of all the diseases of this precious insect are the rapid growth and multiplication, of myriads of inferior organized beings, in vital concurrence with the Bombyx, which kill it very often after a short resistance. Sometimes, all the larvæ die before they have built their cocoons, after all expenses have been made, then it is a complete failure. These diseases are:

First—The flatness, or flat died worms; a most terrible sickness which kills the stoutest larvæ almost instantly, just in the very moment when it is ready to spin. Its characteristics are a kind of cellular chain or chaplets discovered in the digestive tube of the larvæ of the chrysalises and of the moths, by Mr. Pasteur, a celebrated French Academician. These cellular ferments have been scientifically named Bombycis microsimas. This disease, accidental and hereditary, but not contagious, can't be seen in the eggs. It can be avoided by the careful examination of the moths, provided that each one of them has laid its eggs upon a small sheet of linen, where it has been pinned up, for ulterior examination. This way of isolating the moth is called Pasteur's or cellular system.

Second—The pebrine, from the provincial word pebre, pepper; so called because the larvæ, in the last period of the sickness have

their white skin covered with small, black, pepperlike spots. It is characterized by the vibrating Cornalia's corpuscles, so called from the learned Italian Cornalia, who first discovered them under his powerful magnifying glass. These oscillating or vibrating corpuscles, bright silver colored, of an oval shape, are found in the eggs, in the bodies of the worms as well as in those of the chrysalises and of the moths. It is peculiarly sometimes, say three or four months after the moths have laid their eggs and died, that the job of examining is the easier, because the corpuscles have grown and become adults in the dead bodies; they multiply considerably too, and then it is very difficult to make any mistake in the selection of the pure or of the diseased cells; nevertheless, the operation must be made carefully, for this disease is hereditary and contagious to the last degree.

Third—The Muscardine, characterized by a microscopic mushroom, discovered by Dr. Bassano, botritis bassania, which attacks peculiarly the breathing apparatus of the worms. This plague is accidental, not hereditary, but it is sporadical, and its rapid propagation is to be feared. The worm first dies suddenly, white and flat, then a few minutes after it turns rigid and snow white or pink, seemingly covered up with mill flour, or pink dust; such are the characteristics of this redoubtable plague; I never heard of in the United States, but common enough in northern quite rainy latitudes.

All these diseases and a few others of a less dangerous character are the result of domestication, of a wrong way of breeding, of the fermentation of the litters, and of the infection of the air. The asphixia, or suffocation of the larvæ, is brought about too often by shutting the doors and windows after lighting fires, in order to get a certain degree of temperature.

The diseases of all kinds are surely created by a bad hygienic condition, bad kind of food, such as many varieties of mulberry trees, fermented leaves of the best kinds, in so many words, all of which produce in mankind rheumatism, purulent infection, typhus, and yellow fever.

Let us see, now, what is to be done to fight or prevent these disastrous epizootics and what means have been employed to this day. For the muscardine, we have only æration and cleanliness. Disinfect the room, if you have been forgetful of this important rule; that is all. As for the pebrine and flatness, all means have been employed. The diseased breeds have been crossed with sound or wild breeds—Chinese, Japanese, etc.—by importing at a great cost, every year, eggs from silk countries thought free from disease. Later, Cornalia examined the eggs, and declared them worthless, when they were found to have more than four per centum of corpuscles. Pasteur mashes the dead bodies of the butterflies, submits that dirt under his microscope, and keeps only the eggs of the ones pure of vibrating corpuscles and of cellular chaplets and chains.

These cases have given the most brilliant results. Cornalia found the means to discern and surely state the disease. Pasteur, helped by his discoveries, has found the means to procure good, sound seed. Both have equal rights to the eternal gratitude of all the silk-growers; both have immortalized their names, though neither of them found the means to regenerate the silk-worm breed definitively, completely and absolutely. And to reach this end it is only necessary to restore them to their natural primitive state, or, at the least, breed them after nature as near as possible.

I will not mention here the experiments made at Boissere's by myself and by Mr. Clair, though we have seen our fine French—but quite pebrined—breeds completely restored to health upon the mulberry tree. There they have enjoyed the dew, the rain, the sun, and once a light snow; and not only none of them were sick, but they have engendered a stout breed, which did very well in France and in Italy last spring, while European and Japanese breeds were dying at the rate of seventy

to ninety per hundred. The *fait* of Dr. Baley, from Jackson, Miss., who succeeded so well with the same breeds regenerated at Silkville, and bred by himself in his gallery, in full open air, is not to be mentioned either as a conclusive experiment; but both these cases, with many others, may be quoted in order to enforce the experiments of eminent observators and sericicole authorities, who, long before us all, solved this important problem.

In 1859, at Milan, Italy, Mareschal Vaillant attempted, with great success, a small breeding in full open air. The same was repeated on a larger scale by learned Taverna, of the same city, in 1860, with same encouragement. The eminent sericulturists and learned men, Martins, from Montpelier, Prollin, Andre, from Anduze, and many other naturalists in France, have deposited the young worms, or even the eggs, upon lots of mulberry trees previously covered with nets, in order to protect the larvæ against the birds, etc., and succeeded, with sound and diseased breeds, to perfection. But, in spite of their universal success, these means are impracticable--the ants, rats, mice, spiders, etc., or the hail, being a constant and unavoidable danger to the crop.

But if the breeding upon the tree is not feasible, Mr. Gintson, from Bordeaux, has proven by breeding lots of not less than 240,000 to 400,000 silk worms in full open air, that this way is the best, as it is the cheapest and the surest.

In 1869 he began with 240,000, or four ounces of eggs, belonging to three different provinces, one of which was quite infested with pebrine and flatness. The young worms were kept the first ten days at Bordeaux in a room whose doors and windows were constantly kept open; then for eight days in a greenhouse largely ventilated. In spite of these good conditions, the disease beginning to appear, and many worms dying every day, they were brought upon two rows of shelves, supported by posts fixed in the middle of a large meadow—the shelves made out of willow canes or lattices, between which the air circulated easily, drying the litter so rapidly that cleaning was judged an unnecessary operation. A shelter of rough boards protecetd the worms against the hail, but not against the rain. The side walls were made of rough linen or nets, just good enough to keep the birds away; the posts surrounded with a piece of tin to prevent rats and mice from climbing up the shelves. The temperature went as low as sixty Farenheit twenty-four times, and as low as fifty Farenheit four times.

In these conditions not another worm died—400 pounds of cocoons out of four ounces of eggs. Such was the result. The experiment has seen its fourth repetition on a larger scale with the same success. Whether the eggs were diseased or sound, there was no difference in the splendid product.

In China, in many provinces of Japan, in Syria, in Asia Minor and other Eastern countries, I have visited for six years for the purpose of selecting the best breeds and the soundest for the Sericultural Society, of Largentiere, my native country. I have seen the worms bred in the galleries or in full open air, protected only by rough nets or carpets hanging round the shelves for the time, and returned to their destination after the silk season was over.

It is true to say that in northern regions the breeding in such conditions would be very long and tiresome, but in southern latitudes nothing cheaper nor easier, as the cane sheds, the gins and house galleries will be there the best spots to raise the silk worms, after the second transformation or molt has been performed in a smaller room.

I hope this demonstration will show the northern breeder, obliged to light fire in the cocoonery, the necessity of combining heat with ventilation, and the southern will understand that the rules made for Kansas or Iowa, Valakia or France, are useless and hurtful for Louisiana and Alabama, or Syria and Portugal breeders.

Since the only means to restore to health the diseased worms is to raise them in nature's fashion, approach, imitate nature, save trouble, save money, and go on in security.

COCOONERY OR MAGNANERY.

Whether the breeding is small or large, it is necessary to be able to give heat or ventilation at will. With small breedings these conditions can be easily obtained, for often the silk worms there raised will fail much to fill up the premises, whether room, kitchen or stable, which they are to be accommodated with. Then the bulk of air being proportionally very considerable for the small quantity of worms, the air could not be vitiated; still, if the apartment is hermetically close, it should be renewed once in a while. To do it one needs to have each window fitted outside with a frame covered with light cloth. At about 9 o'clock in the morning, when the warmth makes itself felt, open the windows; the air infiltrates slowly but continually through the cloth, and cools the apartment without blowing too directly upon the worms, while a sudden change of the temperature might prove hurtful to them. When it is getting dark let down the window sashes again, and start a fire in the stove before going to bed and after feeding the last meal. Never start a fire without at the same time feeding leaves, too. If you have no thermometer, remember that where you feel comfortable, clothed in light breeches and shirt sleeves, the worms, too, feel comfortable.

When a larger quantity of worms is to be raised, the construction of a special building becomes a necessity, and as it will be used for that particular purpose only for a month, every one will be at liberty to use it the balance of the year for something else, such as stable, hay loft, store-room, etc., which lessens the expenses to be charged on that crop. Still, while disposing your cocoouery, with an eye to the corn, wheat, cows or horses, you must keep in view its first destination. Therefore, if you can afford it, you will have a cellar underneath, to keep your leaves fresh. In the floor, between the cellar and the cocoonery, valves should be disposed at distances along the passages, so as to be opened or shut up at will, to admit cool air in sultry, warm weather.

I have not seen such case here yet, and I do not know if it can happen in this country, where the wind blows constantly. I only foresee the occurrence for such as might meet with it, whether here or elsewhere. By the way, it is not expensive. If the ceiling is made of nailed and grooved boards, let there also be an equal number of valves, corresponding to those in the floor below. Loose boards for the ceiling would do better, or at least have one loose board above each passage that could be opened or shut at will. There will be one or two chimneys for one or more stoves, according to the size of the building or room. Have the windows on the east and west sides, and the door on the south, all fitted with sashes of light cloth, a means of ventilation which I believe to be quite sufficient for our climate. I have not used any other here, and succeeded well. Still, it must be borne in mind that I do not speak for Louisiana only, and the years may not be all alike. Beware, then, of neglecting such easy means. Build up your cocoonery with bricks, stone or boards, with one or two stories, as you please, or as you can; if the ventilation is good, all will go well.

DISPOSITION OF THE TABLES IN THE COCOONERY.

The tables or trays, which are to receive the silk worms, are made in various ways; sometimes with wide, rough boards, but fitting well together, leaving no cracks through which worms might fall; sometimes they have hurdles made of willows or cleats, covered with paper. These tables are supported by four posts, connected by cross pieces, on which the table rests. Their maximum width must not exceed six feet, so that a person can reach with the hand to the middle of the table in feeding or removing the litter. There needs then be a passage left between each row of tables; if there are two rows the passage in the middle must be a little wider than the other two. Three feet are enough. and even less would do when circumstances require it. Verti-

cally the space between one table and the next above must be one foot, or a little more, if you have room to spare, so that in the last days a room seven feet high can contain six tables placed over each other. If there are too many worms, part of them may be put on the lower floor and part on the upper, which will make eight tables for seven feet height of the room. If each table is six feet wide by nine feet long, that is, fifty-four square feet, you have with eight tables 432 square feet, which may hold from 180 to 200 pounds of cocoons, or about 50,000 silk worms, who will eat 3600 or 4000 pounds of leaves.

From the number of mulberry trees, two, three, four or ten years old, one can see at once how many times he can have 4000 pounds of leaves, and therefrom how many rows of eight tables, or much better of ten tables, he will need in his cocoonery.

Ladders are generally used to tend to the upper tables; stands or shelves are handier, by far. At man's height crosspieces, sufficiently strong, are set across the passages, resting on the vertical posts on both sides for the middle passages, and on the posts and wall for the side passages. Then a strong, thick board is laid on the crosspieces along the tables, to stand upon. In this way the work is more rapidly and easily done—of course this is only in rooms higher than seven feet.

VARIOUS DETAILS OF ATTENDANCE.

Removing the litter is done in this way: Whole leaves are thrown to the worms; then both leaves and worms are taken by handfuls and set aside, while an empty spot is made and swept clean immediately so that the worms do not remain piled up too long, and so forth, for which operation small, short brooms are used, made of weeds, briars, or no matter what. In the Ardeche they make use of tame or wild thyme, which perfumes the floors and embalms the apartment. Our farmers fancy that the worms like the perfume, but it would be difficult to prove that they are right, for if the worms are more quick, active and in better appetite, it may be due perhaps to their liking for cleanliness, without caring for the perfume. They succeeded with or without it.

In large breedings nets are used, which are spread on the worms, taking care in lifting them up to pull evenly by the four corners, in order that the middle does not hollow itself into a bag. As soon as two or three meals have been fed, the first net is lifted up and removed with the worms on; the litter is cleaned. This makes room for another net, and the job is soon done in this way, for it is the most expeditious way to do that work; for the first ages, once at each moulting, and for the last ones, at least twice. Some make use of perforated paper instead of nets. It is well understood that two sets of nets are needed, for the first spread remains where it is till the second operation takes place, and is then removed with the litter to make room for a new net with worms and leaves, and so forth. Whatsoever way is used to clean the litter at the last ages, let doors and windows be wide open, except in case of particularly cold weather, and that day, as always, remove all dirt as you proceed cleaning the trays, and then sweep clean.

To pick the leaf and to *distribute it* in the easiest way, bags must be fixed to the waist by strings or leather straps, having the bag just long enough so as not to drag on the ground and interfere with the worker's movements. Women use smaller ones, easily filled up and emptied. Any other utensil is heavy and cumbersome.

If the worms are fed very often, say five or six times a day, each meal needs to be very light, spreading one leaf in thickness on the worms; but if, on the other hand, they are fed but three times a day, more leaf is thrown at a time. But in all cases it must be spread with the utmost regularity, lest the worms should eat more in one place than in the other, otherwise it would be altogether impossible to keep them even. As I said before, the worm that eats six meals in one day is as much forward as the one that takes three days to eat the same number of meals. Therefore, if in the distribution of the leaf some places get

double the quantity that others have, the worms of the first will have two meals, while their neighbors get but one. They will undergo their moulting while the others keep eating, and at the cleaning you are pretty sure to throw away either the first or the last ones. Yet, if such a thing should happen, there is a simple way to remedy it. Here it is:

When you see many of your worms asleep—that is, which stop eating and allow themselves to be covered with leaves, while others continue eating greedily, throw them large leaves, and as soon as those who eat have crept out, take them up with the leaves and remove them to another place; then wait till the others are done moulting before you feed again. In this way out of one party you make two, one of which is ahead of the other, but in each of which all the worms are respectively even. Such operation is rapidly done with nets.

It is necessary to have a cellar or any other cool place to keep a provision of leaves, particularly in rainy climates where one often has to pick leaves for a day or two in advance. In our Southern climate I believe that two meals picked beforehand will be enough, so that one needs not gather them too early in the morning with the dew on, or in case of a sudden storm which might overtake you when you are without leaves picked up, and compelled to let your poor worms fast.

The good keeping of the leaf is most essential, and it is very easy too. In putting it in the cellar, or elsewhere, care must be taken to shake and stir it thoroughly, so as to admit air, notwithstanding the thickness of the heap. When it has settled some, it must be stirred again, if it commences heating, but above all that, such leaf must never be fed before it has been shaken once or twice, and before you are satisfied that none of it has been spoiled by fermentation, or is fermenting yet. Do not forget that, for such an oversight you might have to pay dearly by killing a good many silk worms, when the expense is already made, or nearly so, for the leaf is put in large heaps only near the end of the breeding, when plenty of it is wanted every day. Rain or pure water on the leaf never injures the silk worm, but the dew or dampness resulting from the fermentation will kill them surely. In its natural state the silk worm—*bombyx mori*—remains benumbed during the night and the whole morning, till the heat of the sun or air quickens it from its torpor; it then never eats any dew. The hurt resulting from wet leaf by rain does consist sometimes in suddenly cooling an animal used to a warm atmosphere, which brings death. It does, too, always maintain too much dampness in the trays and in the room, and causes the fermentation of the litter. If, out of necessity, you are obliged to feed wet leaves, set up a bright fire—blazing fires are best—to dry up and renew the air.

EXTERNAL AND INTERNAL ORGANIZATION OF THE SILK WORM.

We have already seen through what series of transformations or changes of skin the silk worm, like any other caterpillar, encloses itself in the most admirable tissue, and becomes a chrysalis and then a butterfly.

Let us examine with a magnifying glass the insect's head, its mandibles, its thread-spinning apparatus, legs, skin, and all its organs internal and external. A marked swelling, covered with wrinkles, at the fore part of the body looks like the worm's head, but has only the appearance of it, and contains a greasy liquid. The hard part, which forms the snout, is the true head; it is composed of indented mandibles, set side by side, hard, strong, movable, very fit to take hold of the leaf every way, making the first cut on the sides as well as in the middle, from their very birth; the other part of the head is the (filiere) threader, a kind of membraneous apparatus, set with muscles, which presses as they pass, and strongly joins together by means of a gummy substance, two silk threads so adherent that they can be severed only by means of powerful chemical agents. These two silk threads are slipped out of

two inner reservoirs, full of a transparent liquid, which hardens in the air and becomes thread by a phase of nature, easier recorded than explained. Two black points adorn the head of the silk worm; some people think they are eyes, and some say they are not. The feet are articulate, membraneous and fitted with hooks, whose principal use is to fix the insect in any position. There are six of them in front, articulate, used for motion, and eight at the back, membraneous, whose principal use is to fix the insect in any position; they are called false feet, and are lengthened, taken in, and expanded, according to the insect's wants. Twelve rings, alternately widening or nearing each other, are used for locomotion; last of it, upon the extreme back is a protuberance, a kind of tail, the use of which I ignore. At each side of the body there are nine black points. They are apertures which supply constantly to the larva the amount of air which it needs so much. Inside nearly five thousand muscles have been counted, used for locomotion. The intestinal tube extends in straight line along the whole length of the body; it presents many inside divisions, and is externally surrounded with many small channels, used for digestion. On each side of that tube are the two long reservoirs which contain the silky liquid; they extend to the head where they unite with the threader or filiere, thus forming two threads that join on the outlet, as we have before said. It was an error, very generally received, that the silk thread was already formed inside of the worm, but it is now proved that it is nothing but a liquid, which hardens as soon as it comes in contact with the outer air.

At each moulting the silk worm changes the whole of its outer envelope; snout, skin, feet. When at its greatest development, about twelve or fifteen meals before the going up, the yellow silk worm is three inches in length. When just hatched, it is not one-twelfth of an inch; yet God, who pleases to show the perfection of his work, as well in infinitely minute beings as in colossal ones, supplied it already with every thing. This animalcule is provided with a breathing apparatus, its five thousand muscles of locomotion, and its threader. It spins when being born, even before its first meal. Take the paper or cloth on which it has been hatched and you will see it hanging by the silk, an almost invisible thread, which in state of nature protects it against falling from the foster tree, and by the help of which thread the wind shoves it softly to the nearest limb or leaf from the rough bark on which its egg was affixed.

A WORD ON SPINNING AND MILLING.

Spinning is the art of extracting silk out of the cocoon. It is not very long since when, in France, every cultivator used to spin his own crop. In many parts of the Cevennes they do it yet. In the corner of the yard, under a temporary shelter built up out of rough boards used in the cocoonery, they set up a small stove fitted with a grate, and a copper or cast iron round wide basin. The whole is just high enough to be in the reach of the spinning woman sitting on a common chair; an axle is fitted with a reel of about two yards in circumference, of six or eight bars parallel, and fixed on suitable arms, in the same position as the reel of a harvester used to bend the standing grain against the sickle. Such a reel is mounted on a stout, square, long bench, with four legs, and motion is imparted to it by means of a crank, pitman and footboard (the pitman being simply a rope). A boy or girl dance on that for a whole day at a time. The cocoons being in the basin with hot water, the silk that comes out of them passes through four glass needles. The two first, placed close above the copper pan, are set on a small table, on one end of the bench, which receives all the trash, such as bare worms issued from completely-reeled cocoons, bad cocoons, etc. These glass needles are set about five or six inches apart; the two others are set on a wooden strip in the middle of the bench between the first needles and the reel, which, by a combination of cogs and wheels, imparts from them a back-and-forth motion, whose extent deter-

mines the width of the skein, which winds itself around the reel. The reel itself is covered with a white cloth, intended to keep the silk from coming in contact with the wood. The spinning woman, when her first water is sufficiently warm, and stained with smashed chrysalises proceeding from already wound-up cocoons (worms' water), takes about a half pound of cocoons in the basin and beats them softly with a broom made of fine briars; after a moment she draws and shakes off all the downy stuff (*bourrette*), which by that process appears to be loosened from the cocoons, then the cocoons also upon a long, smooth board which she keeps before her. That being done, a few cocoons are thrown in the pan, and let the thread be seen which joins them to the heap laid on the boxes. The spinner takes four of these threads, passes them through a needle, then four more which she passes through the other needle, after which, gathering the two quadruple threads between the thumb and forefinger, she twists them together, in order to make what is called the crossing. The longer the crossing is—say, twenty to thirty turns, one thread on the other—the more each four cocoons' thread is even and strong. That crossing done, the reel-turner takes the two thread ends, passes them through the moving needles, the threads forming an X from the two first threads to the other two, and then, last, fastens them to one arm of the reel, which she then starts in motion with all the elasticity of her strength. I have seen women spinners to wind in that way one pound and a half in a day, when the cocoons were good. At night the silk is taken off, folded, and little by little is piled away in the the walnut chest, where it waits for the right time to be sold. In the good breeds, with a careful and experienced woman spinner, ten pounds of cocoons give one pound of silk. Put the cocoons at sixty cents a pound; that will bring the cost of one pound of silk to $6 or $7; it may be sold for $8, $9, or $9 50. It is well understood that I speak of the prices in France for five or six years. The girl of the house, assisted by her little brother, have learned the difference; and, besides, there is the refuse silk, which pays three-fourths, and sometimes the whole of the spinning expenses, when strangers have to be hired.

The home industry tends every day to disappear. First, because the silk spun in that way, cannot stand the competition with those produced in the large spinning mills, which cost less and yet are better, and of course of easier sale. Indeed, a farmer needs a woman spinner, a reel turner, then a stove for each basin; while 200 or 300 reels or more are moved by one engine, the same that supplies the two or three hundred basins with hot water put instantly to the right degree of heat by means of two cocks with which each spinner is provided, one for cold and one for hot water. Add to that enormous economy, the perfection of the work due to the classification and selection of the cocoons, and sometimes to the rapidity too, with which it is impossible to get rid of all poor and stained cocoons. These kinds want to be spun when fresh; dry, they yield very little, with much difficulty and very bad; fresh they are worth the others, if well spun. The owner of 200 basins can do it, the farmer cannot. Last of it, there is more profit for the farmer, and it is easier for him to sell his cocoons as soon as they are ready; instead of waiting four to six months to sell his silk, sometimes at retail week after week, he will sell his goods and be paid for them all at the same time, which is pleasing enough. If he happens to be of small means, if his children have to earn their living, they will find in these very factories a steady and well paid occupation.

The spinning stands foremost in order, and importance among all the silk industries. With the improvements brought to it, and which are being made to it constantly, the most admirable works are executed, almost all to order; they ship three, four, twelve or twenty-five cocoons, according to the order received, whether it be at three or four for the finest fabrics, or at twenty-five or thirty for the most beautiful musical instrument strings, and the strongest known.

The annual breeds, green and a few white Japan, the yellow and white of France, Italy, Syria and Adrianople, are spun at 3¼. They call a half cocoon that which is nearly finished, almost done winding. The last end of the thread is much thinner than the first one and the middle. Among these breeds, it is not unusual to make one pound of silk out of nine or ten pounds of cocoons, but from eleven to twelve pounds is generally considered to be a fair average. The double cocoons forming a catalogue by themselves, which sells for only one quarter the price of the single ones, are in these breeds in the proportion of from two to ten per cent. Their value, and that of the silk made out of them, keeps them almost constantly at a good price, even in time of commercial crisis. People going into silk culture, will do well to content themselves with the raising of the most improved breeds.

The breeds of second quality, yellow of Caucasus, yellow and white of the Balkans annual breeds, green and white of Japan Bivoltines and annual too, use often from sixteen to twenty-four pounds cocoons for one pound of silk. The thread of these is generally downy, and has but little sinew in it. The prices of these are invariably inferior, and they can be sold only at a loss, in time of commercial crisis. Bivoltines of Japan average from twenty-five to thirty per cent double cocoons, to add to these other defects.

The white Trivoltines yield a pretty fine silk at twelve cocoons for one thread, they are very hardy too, and succeed admirably; they go through their five ages in twenty-two days, but they include from sixty to ninety per cent not double, but treble, quadruple and sextuple cocoons; like some breeds of Portugal, beautiful yellow cocoons, very fine, who have likewise the defect to join sometimes eight or nine in number to make one cocoon, which of course sells for ten cents a pound. If I speak to you about them at all, it is just to tell you that they do exist, and to advise you to keep away from them, avoiding to apply to unknown parties to supply you with seed. For it is sadly true, that among silk worm dealers there are many unprincipled men, who will sell under good breeds these worthless, ruinous kinds consuming much, to yield nothing.

Happily, too, respectable firms are not wanting; one need only to procure reliable information. And then too, let us hope that in a short time we are to become the supplying market of the silk world.

From the spinning mills, silk goes to the milling factories, so called. Spinning and milling form together the richest, the most vital, most productive of all known industries. Spinning makes the silk, milling gives to it consistency and fits it for all subsequent operations, whether it be intended to become dress silk, velvet, ribbon or sewing thread, etc.

Coming from the spinning mill in the shape of skeins, silk is wettened with purified olive oil and superfine soap, to remove the gum, to supple it, and to make the winding easier and less costly. Winding implies the tieing of every broken thread the removing of all down or other obstruction which stops between the piece of cloth, silk or leather through which the silk-threads are made to pass before winding themselves around a spool and in a ball. The spools or balls are again wound off, in order to undergo a cleansing operation, through very tight sheets of cloth, between two Y-shaped iron pieces, which do not let anything pass, the least knot, the smallest particle is there stopped. Thence to the milling, where they undergo a first preparation after the doubling, and last to the second milling, called twister, where they are submitted to the torsion and last preparation. There the skeins are tied and kept ready to go to the dyeing and weaving.

There is now nothing left to do but the folding and packing; two delicate operations entrusted only to special and well paid men. In factories overseers generally have these last cares in charge, of which the most delicate and difficult is the matching of the various shades.

According to the quality and breed of the cocoons, from which they proceed, silks want more or less working, and average a greater or less

percentage of waste. There are China and Bengal silks which require four hands to manage each row of twenty spinning wheels, and they do not enjoy a minute's rest, besides making an enormous waste, while they will manage a hundred wheels each, and take it easy, if they work silk from Broussa, Fossombrone, or other first rate silk, spun in first class factories. As a matter of course, too, the waste in these last silks is scarcely worth mentioning, for its only source is in the thread wasted in tieing, when it breaks, and in the downy obstructions which need to be removed.

The whole of it then lays in this principle: To cultivate none but the finest breeds of cocoons, in order to reap the fairest, the most remunerative products, with the least possible expense, and to secure an always sure sale.

RECAPITULATION.

I receive so many letters, so many questions about silk culture, that it is not possible for me to answer them singly. This last chapter will answer better for all.

Many ask if their climate or country is good for silk worms. It has been said wherever the mulberry tree finds a congenial climate and soil, the breeding of silk worms will succeed.

The silk worms require a pure atmosphere. It has been observed that when raised in poor peasants' huts, enjoying the pure air through the cracks and broken windows, they succeed better than a large lot nursed in a spacious and costly building. Then it is better to have four cocooneries, of eight hundred pounds capacity each, than only one containing thirty-two hundred in a single large room; that plan is now followed by every rich intelligent farmer in silk growing countries of Europe.

Some claim noise, storm, thunder, to be prejudicial to silk worms. It is an old error; for the poor farmers in France have lost many and many nice crops, by shutting their windows and their doors hermetically when the storm was threatening. But that precaution and the heavy atmosphere, without a single breath of air which always precedes thunder and lightning, they would choke or stifle an ox as well as worms. In such a case, let the air penetrate in the cocoonery through the sash of every door and window, and every means of ventilation you have. Burn some straw, or dried bushes through the passages, to purify and renew air abundantly, instead of shutting doors and windows, and let lightning, thunder, storm, shocks of electricity of every kind do their best, your worms will be the same after as before.

Another argues that work is dearer here than in France, and silk will cost too much. My mother shall give you an answer. The following is an extract from her letter: "We have had plenty of cocoons, grapes, figs, chestnuts, apples, plums, peaches, etc., all of the best quality, but workmen are dear and the price of labor increases every day. A girl is paid 100 francs per month, and men fifty cents per day in silk time." They feast, you know, all the time with wine and every thing. "You are happy," she adds, "to raise your silk worms without fire; here we must pay very dear for coal or wood, and a special woman or man to regulate the fire from the beginning till the end." That only constitutes half the expense of the breeding. Then the difference in the price of labor here and in France, does not exist any more. We can raise silk cheaper with less than half the trouble. If the farmers consider that there is no culture more remunerative, and with that culture they will grow rich and enrich the country too, they will enter into the business directly.

Silk worm breeding is so simple, that after the the first experience made the first year with the few leaves you will pick in pruning your young trees, this small book in hand, the wife or the eldest daughter shall superintend the work of feeding, clearing, etc., and tell to the younger ones what they have to do.

Farmers blessed with a large family, let your children have a lot of

mulberry trees, in that way they will cost you nothing; they will be able to give you a nice profit, be independent and able to support themselves from the product of one acre, going to school ten months—two months being sufficient to plow or cultivate mulberry trees, to feed silk worms and clean the cocoons.

The feeding and taking care of the worms and cocoons, the reeling of silk, all this work in silk countries is done by ladies. This will also be the case in America, and a great improvement and benefit for them. They will certainly be proud to wear fine dresses made by their own hands. It is as natural to the woman to dress in silk cloth, to which she gives a new glare, as to the butterfly to shine among flowers, as to the flower itself to bloom in the sun ray.

I have read somewhere that only one of our States sends about seven millions of dollars annually, to import silk for our ladies, our dear ladies. How immense, then, must be the amount sent by all the States.

Farmers of America, it depends on you that every girl might wear a silk dress, for in a short time you can raise silk for your consumption and also for exportation.

I have said enough in this little book to enable you to carry on a profitable business all over our country, but experience will teach you and me from year to year. I will be grateful to any one who shall succeed in his first trial, to tell me how, under what circumstances and by what means he succeeded, taking peculiar notice of the origin of the seed. If you fail, I would also thank you to send me the cause of your failure, that in the future we can enlarge this little book, and cover all the points of instruction which future experience will give us.

Remember that I am at your service, always ready to explain to you what I have omitted or what you do not understand in this small treatise. Now my last word is: go into this business immediately, both for yourself and for the country; the sooner the better.

COMPLEMENT TO SILK CULTURE IN AMERICA.

WHAT SERICULTURE PROMISES TO MILLIONS OF IDLE HANDS.

We have at this moment to maintain a polemic against the enemies of silk culture (sericulture) in America. Those enemies are—who would believe it?—mill owners and manufacturers forming the Silk Association of America. Let us hear their reasons and meet them squarely. I do not intend to reopen the errors published in 1876 in a book entitled, "A History Prepared for the Centennial Exhibition;" facts have refuted them a hundred fold, and it is well settled that the silk worm, reared under good conditions, thrives marvelously in several States of the Union. Their suggestions about persons who expect to raise silk worms, tending to discourage beginners and to hinder the general trial of this culture, are already swept away by the success of more than a hundred fruitful attempts before and since 1876. Their most serious allegation is the high price of the labor, which renders spinning impossible. Take their own words as found in the report of 1876, page 48:

"In China or Japan the skilled labor of the artisan, inherited through more than thirty centuries of the same kind of toil, is amply repaid by from five to ten cents per day. A good reeler there will reel two pounds per week, and is satisfied with eight to ten cents a day. Here even the poorest Chinese reeler would demand from seventy-five cents to a dollar a day. None of our Yankee girls would be willing to undertake it, though perfectly ignorant of the process, for less than $1 a day. * * * Our friends who are determined to raise silk worms can do it in one way, *and only in one*. There is a good market, and is likely to be for years to come, if it is not glutted, for silk worm eggs in France and Italy. * * * The needs of that

market will furnish employment for a reasonable number of silk growers, while the pierced cocoons will find a ready sale, though at *a lower price*, to our manufacturers who are producing spun silk."

In speaking thus, these gentlemen are completely in error. They are ignorant, or affect to be ignorant, that distress is engendered in a country for want of industrial pursuits to occupy millions of idle hands, which is refused to them even when they offer their services for life. Women, at least in the West, have no sort of occupation; every farmer has children to place out, and when they are lucky enough to find in stores or hotels places for their daughters at $1 50 per week, they accept with joy. Not one of them selling corn at fourteen cents or sixteen cents a bushel, and his meat at $1 75 or $2 a cwt. has means to pay a workman, and scarcely to dress his children decently. Lack of consumers and high freights, these are the causes of poverty in the midst of plenty. Let us see whether in this State sericulture would not be of some use, without caring whether the Japanese or Chinese are paid by ten cents or ten blows on the soles of their feet.

It has been proven that one man can raise in a very limited space—a corner of his barn or his cottage—a hundred kilogrammes (a little over 200 lbs.) of cocoons. To be quite within compass, let us give him four children. If there are four children, from the 1st of May to the 10th of June, on an acre of mulberries of good stock, these four children would pick 400 pounds of fresh cocoons. No doubt about it; but then arises the question of the Silk Association in particular, and everybody in general. What will they do with it? Where's the market? A spinning factory cannot exist and flourish unless the country for forty or fifty miles can supply an abundance of cocoons.

It is not more than fifteen years ago since the silk growers of the Cevennes, in France, were spinning their own cocoons, and they were in a prosperous condition. We might do the same here; every farmer, for the sum of $5 or $10, might fit up a spinning wheel. His sixteen year old daughter could run it; another of ten or twelve could tend the reel, and in three weeks they will run off four to six, then eight to ten ounces, a day of white or yellow cocoons of good quality. There we have three pounds a week. I will not put the price at $12 a pound (which was offered me in 1876), although the spinner, a Yankee girl, had had only two months' practice. We had better put it at current rates, say $6 50 a pound. The figures quoted by the association itself are $8 to $9 a pound. At this rate three pounds of silk will bring $27 in money to the family stock. Ten or eleven pounds of fresh cocoons will make one pound of silk, the same as three and a half to four pounds of dry cocoons. Thus 400 pounds of cocoons, picked by four children, four weeks, would give thirty-six to forty pounds of silk, or $360 in full. This would have employed two girls for nine or ten weeks under the mother's eye. I simply put these figures, and I need not ask fathers of families whether they would prefer this position to that which hard times imposes on them.

When the production of cocoons is not enough to induce any one to start a factory, there certainly would be speculators who could estimate the cost of a small engine for heating the water for 300 basins, and do away with the hands of 300 or 400 boys almost by the same power. This would be self-evident when they remember that the defective cocoons and other waste are worth at the lowest price $2 or $2 50 a kilogramme, and pay for a good deal of the labor. At first the spinner would have to gather his cocoons in small lots for perhaps hundreds of miles, and with a heavy charge for railroad fares. He would have to train workwomen that might waste stock and never be worth their teaching, or would leave him at last to go off and act as teachers in new shops. He might have a lot of apprentices to train, and his product would be inferior to that produced by more skillful hands. For these reasons it would be expedient that for the first ten years, whether the industry be in the hands of farmers or large capital-

ists, it should be protected by a tax on raw silk, the same as now on manufactured silk, so that the manufacturer should pay a fair price for the raw material. Here the association would cry aloud, of course—we touch them to the quick. Then let us try another way. In place of duties, why not pay the silk raiser a premium of 80 cents to $1 for dry cocoons, or $1 to $1 50 for spun silk? In this way the difficulty of encouraging production without injuring manufacturing would be avoided.

And now for a word about the mulberry.

The mulberry accompanies the vine to the highest range of temperature. It will grow on any soil that is not swampy. In old times, only the black mulberry was known. The old naturalists, Pliny and Dioscorides, make no mention of the white mulberry (*morus alba*). In 1570 one Mercuriali, a physician of Forli, in Italy, attributed the tardy development of silk culture to their only having the black variety, of which the growth is slow and difficult and the silk inferior. The white mulberry was introduced at Constantinople in 1552. Thence by degrees it passed to Greece and Italy, and at last into France, where the earliest importations still exist. It is difficult to exaggerate the national importance of silk culture.

In a work largely statistical, giving tables of exports and imports of raw and manufactured silk for the last half century, and bringing out clearly the steady growth of the silk manufacturing industry in this country, Professor Riley shows how, from 1740 to 1790, in the Southern and Middle States, the industry has flourished at times under the stimulus of State aid. He traces the causes of the failures, and the point is strongly brought out that they were transient, not permanent ones.

Experiments that have been made in the past, and a series the author has been carrying on for the last ten years, establish the fact that the larger portion of the United States is admirably adapted to silk culture. This is not only proved by the healthfulness of the worms, but by the fact that we have a larger number of silk-producing insects than any other country of the same extent, and that American grown silk is of superior quality. Mr. Riley shows that the time has arrived for systematic, intelligent effort in the line of silk raising. With a large tramp element, with a considerable portion of the population of the Eastern cities out of employment, etc., the cheap labor argument can no longer be successfully made against silk culture. He concludes by advising Congress to build reeling mills, and the silk worm rearers not to plant any mulberry trees, but to raise the silk worms on *Maclura* or hedge plant—osage orange. Strange to say, he argues as to whether we can compete with foreigners either in living as cheaply or producing as cheaply, and he recommends the osage orange exclusively as silk worms' food. He finds at first the means to make silk as dear as possible, and to produce cocoons hardly worth reeling, that will not be bought at any rate by any experimental reeler, though I admit that silk produced by osage fed cocoons is fine and good. But let us demonstrate Professor Riley's error—a very pardonable one, as it is the result of inexperience.

All sericulturists recommend breeding on a small scale; Professor Riley does, too. Let us fix by a given number what we understand by breeding on a small scale. In France and Italy raising silk on a small scale signifies operations with from 200 to 800 or 1000 pounds of cocoons. Large breeders raise from 40 to 200 ounces of silk-worm eggs; a great success to obtain 30 to 40 pounds per ounce, while the breeder of from 2 to 8 ounces of eggs seldom gets less than 80 pounds per ounce, and often 100 pounds or more.

Now, take for example, a very small breeding—say, four ounces of eggs, or about 100,000 worms of first-rate breed. I suppose they will not give 500 pounds, as I have got from such a quantity at Silkville only 400 pounds. I set this question: What quantity of leaves is needed

for such a quantity of cocoons, and in how many meals or in how many days must they be picked?

Answer.—Fed on white ungrafted mulberry (*Morus alba*), one pound of cocoons eats up twenty pounds of leaves; fed on Moretti, fourteen; fed on rose-leaf mulberry, a variety of the white, eighteen; fed on *Morus jacopnica*, or mulberry lhou, fourteen or fifteen pounds of leaves make one pound of cocoons. Let us suppose the osage orange equal in quality to the *Morus alba*. We will need just four hundred times twenty pounds of leaves, say 8000 to re-open the crop. Now it is a fact that from the hatching until three days after the fourth moulting the worm has consumed just half of the food he needs to be ready for spinning. At five to six days for every molt, and three after the fourth, we have about twenty-three to twenty-seven days for picking 4000 pounds. Three days after the fourth moulting each quantity of worms representing 100 pounds needs 100 pounds of food from the *Morus alba* during two or three days, called in French, *Les jours des fraise, ou grande presse* (great hurrying time); then the appetite of the worm diminishes day after day. For five days after the fourth molt they require 4000 pounds of leaves or 800 pounds a day.

The mulberry and the rose allow a skilled man or boy to pick 100 to 120 pounds per hour. I have and can do it myself. A man could easily pick on such trees all the food needed in the most busy time. His wife could feed, alone, the noon-time meal, and together they could feed the evening meal just before supper. Thus a newly married couple could raise 400 times 50 or 75 cents, the average price of the best cocoons that the United States can grow.

I wonder how many pounds a day the same man would pick on hedge plant. If any picker knows it by experience I would gratefully receive his estimate, but I should not like to learn by experience. In conclusion, a commission of learned men and silk culturists was appointed by the French government, at the time when the disease which killed all the silk worms in Europe was in all its fury, to investigate and prevent the scourge. There was then an opinion that the mulberry tree itself was sick, then the osage orange was tried, declared worthless, and set in rank very far after the multicaulis of deceitful fame.

As for the trees I speak of and other choice sorts, they have been created or introduced in China and Europe little by little, by grafting or by selecting the seeds; some, as the lhou, are supposed hybrids, and represent 500 years of constant study and progress. The first axiom to be known by a silk grower is borrowed from Count de Gasparin, one of our most prominent writers on agriculture and silk culture: "The first thing to do for a silk grower is to cultivate the kinds of mulberry trees which give the larger quantity of silk for a given weight; they produce the best, too," and are picked easier. Lessen your work and expenses, and increase the value of your crop.

Among the thousands of varieties of mulberry trees I have introduced the four kinds hereafter described, which have been set in the first rank by all silk culturists for their excellent qualities.

They are: The white mulberry tree. This kind furnishes a great number of varieties, and can be planted as standard, ornamental or forest tree as well as for a silk-producing tree, sound wood, beautiful leaves and sweet fruit.

Rose-leafed mulberry tree; a variety of the white which furnishes itself many other, has larger and heavier leaves; giving one pound of cocoons per eighteen pounds of its leaves, splendid as ornamental tree, not so good as the white as a forest tree; it produces the finest silk known.

The Moretti Elata does not degenerate by seed, sustains the hardest winters better than any other kind. It is fit for standard, ornamental and forest tree. It grows straight up with an elegant shape and luxuriant foliage. As the white and the rose, it does not fear the grasshoppers, rabbits and borers nor the many kinds of vermin which too often

ruin most of the trees in this country. It gives one pound of cocoons to every fourteen pounds of leaves.

Medium trunks can be set from fourteen to sixteen feet apart; dwarf four feet in a hedge, the rows being from twelve to fifteen feet apart.

Morus Japonica, said lhou or Japanese mulberry tree. This kind was introduced in France by Camille Beauvais, and has the largest leaves, giving the same quantity of silk as the moretti. It is so easily picked that French breeders prefer to plant it to any other kind as a cheap silk producer. Its standing well the hard winters, is proved by five years' growth in Kansas. It grows so well by cuttings, that many stems grow eight feet high the first year in our Southern States.

Plant them as dwarf trees, three feet in the row, the rows twelve feet distant.

They can be planted from the first of October until the middle of May, and sometimes in June, after the leaves have been picked for the worms.

The eggs of the silk worm must be free from disease, or failure is unavoidable.

A price of sixty cents or more will be offered by a society newly established, which will spread reeling factories throughout the United States, wherever they can find a supply of cocoons for making raw silk.

It is reported, and I know by the inventor himself, that a new reel which reels with greater perfection and six times faster than any other known to this day, will be used by the company.

Send stamps when you want an answer to your inquires, and details will be gladly given on the matter by

Your obedient servant,

L. S. CROZIER,

Bayou Sara, La.

A TREATISE

ON THE

CULTURE AND RAISING

OF

SILK WORMS

A FEW HINTS

TO THE

FARMERS OF THE SOUTH.

BY L. S. CROZIER.

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